

Ontario. Ministry of the Environment

Moss exposure experiment in the vicinity
of Inco Metals Limited, Shebandowan.

June, 1981

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

MOSS EXPOSURE EXPERIMENT
in the vicinity of
INCO METALS LIMITED, SHEBANDOWAN

June, 1981

D. J. Racette
Plant Pathologist

H. D. Griffin
Chief, Air Quality Assessment

TECHNICAL SUPPORT SECTION
NORTHWESTERN REGION
— : ONTARIO MINISTRY OF THE ENVIRONMENT
February, 1983

INTRODUCTION

A moss exposure experiment carried out during the summer of 1979, when mining and milling operations had been temporarily suspended, showed that slightly elevated levels of airborne cobalt, copper and nickel were present in the vicinity of a 2500 ton-per-day base metal ore concentrator operated by Inco Metals Limited near Shebandowan, Ontario (1).

To obtain information on atmospheric metal concentrations during normal mill operations, a second moss exposure experiment was conducted in June, 1981.

METHODS

Samples of dried Sphagnum moss were exposed from June 2 to July 2, 1981 at 12 sites near the concentrator and at two control locations remote from the study area. Sample locations were the same as those selected in 1979 (Figure 1). As in the previous survey, standard Ministry practice was followed in the preparation, exposure and processing of moss samples (2). Samples were analysed for cobalt, copper, iron and nickel at the Ministry's Thunder Bay laboratory.

RESULTS

Data for both 1979 and 1981 are summarized in Table 1. Concentrations of cobalt, copper and nickel in moss exposed at several sampling locations were significantly higher than levels found in 1979, when the mine was closed. Iron levels in moss were slightly higher in 1981 than in 1979 at some sites (7, 8, 9, 10, 12) near the concentrator. The distribution pattern for nickel in moss, illustrated in Figure 2, was similar to that for

cobalt and copper. Contaminant levels declined rapidly as distance from the concentrator and concentrate storage area increased. Dust from vehicular traffic may have contributed to metal concentrations recorded at some of the sampling points near roads.

Additional evidence indicating that the elevated metals were due to mining activities is provided by calculation of "enrichment factors" (EF) (3). To remove natural variation in contaminant levels between sites, metal concentrations in moss and soil at each location were compared to a single element, iron. Iron was selected since it is easily and accurately analysed, and is not readily taken up by plants. EF values were determined by the following formula:

$$EF = \frac{\text{concentration of element in moss}}{\text{concentration of iron in moss}} \div \frac{\text{concentration of element in soil}}{\text{concentration of iron in soil}}$$

Enrichment factors above those calculated for the controls (approximately 3.5) indicate an ongoing enrichment process over local soils that can be attributed to industrial origin. All enrichment factors in 1979 were less than 3.5 (Figure 3). In 1981, when the mine was operating, maximum EF ratios for cobalt, copper and nickel increased to approximately 8, 31 and 206 respectively (Figure 3).

CONCLUSIONS AND RECOMMENDATIONS

The moss exposure experiments conducted in 1981 showed that airborne levels of cobalt, copper and nickel near the Shebandowan mine were much higher when the mine and mill were operating than when mining activity was suspended. Calculation of enrichment factors confirms that the contaminant was due to mining and milling operations, rather than wind borne soil. Nickel in moss was as much as 225 times the concentration found in 1979, and

nearly 2000 times the level in normal Sphagnum moss. The difference between highest and lowest copper and cobalt levels was less striking, but still very significant. As noted in our earlier report (1), adverse effects on soils and vegetation are a possibility under such conditions. However, since the area of contamination was restricted to Inco Shebandowan property, no abatement action is planned at this time. The Ministry of Labour will be advised of these findings in the event that occupational exposure to the contaminants is to be addressed.

REFERENCES

1. Racette, D. J. and H. D. Griffin. 1981. Air Quality investigations in the vicinity of Inco Metals Limited, Shebandowan, 1979-1980. Ontario Ministry of the Environment.
2. Ontario Ministry of the Environment. 1982. Field investigation procedures manual. Phytotoxicology Section, Air Resources Branch.
3. O'Toole, J. J., T. E. Wessels and K. L. Malaby. 1979. Trace element levels and their enrichment processes in terrestrial vegetation. International Symposium, "Stress in Plants", Los Angeles, California, November 7-9, 1979.

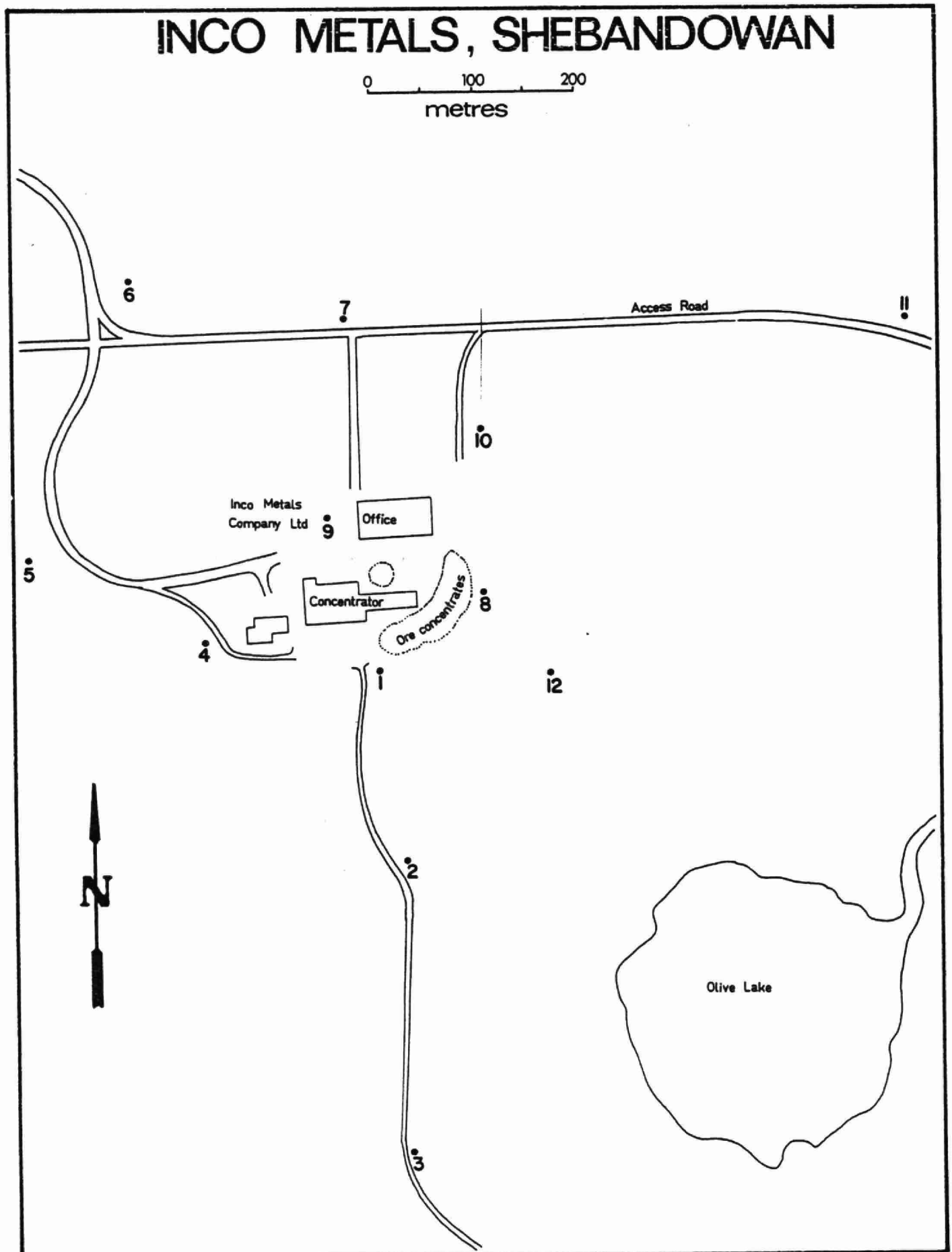


Figure 1. Moss bag exposure sites, Shebandowan, 1979 and 1981.

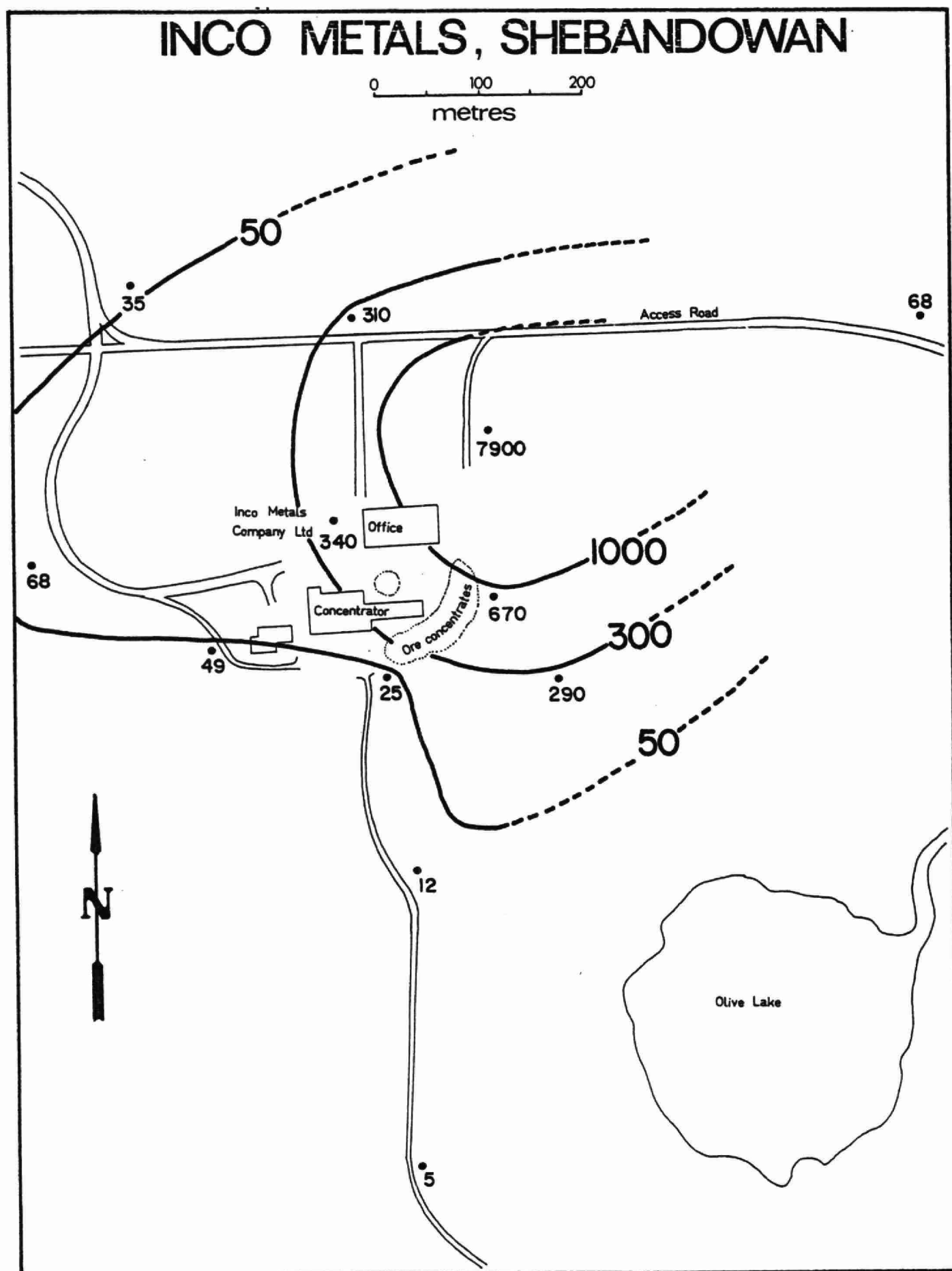


Figure 2. Levels of nickel ($\mu\text{g/g}$, dry weight) in moss, Shebandowan, 1981.

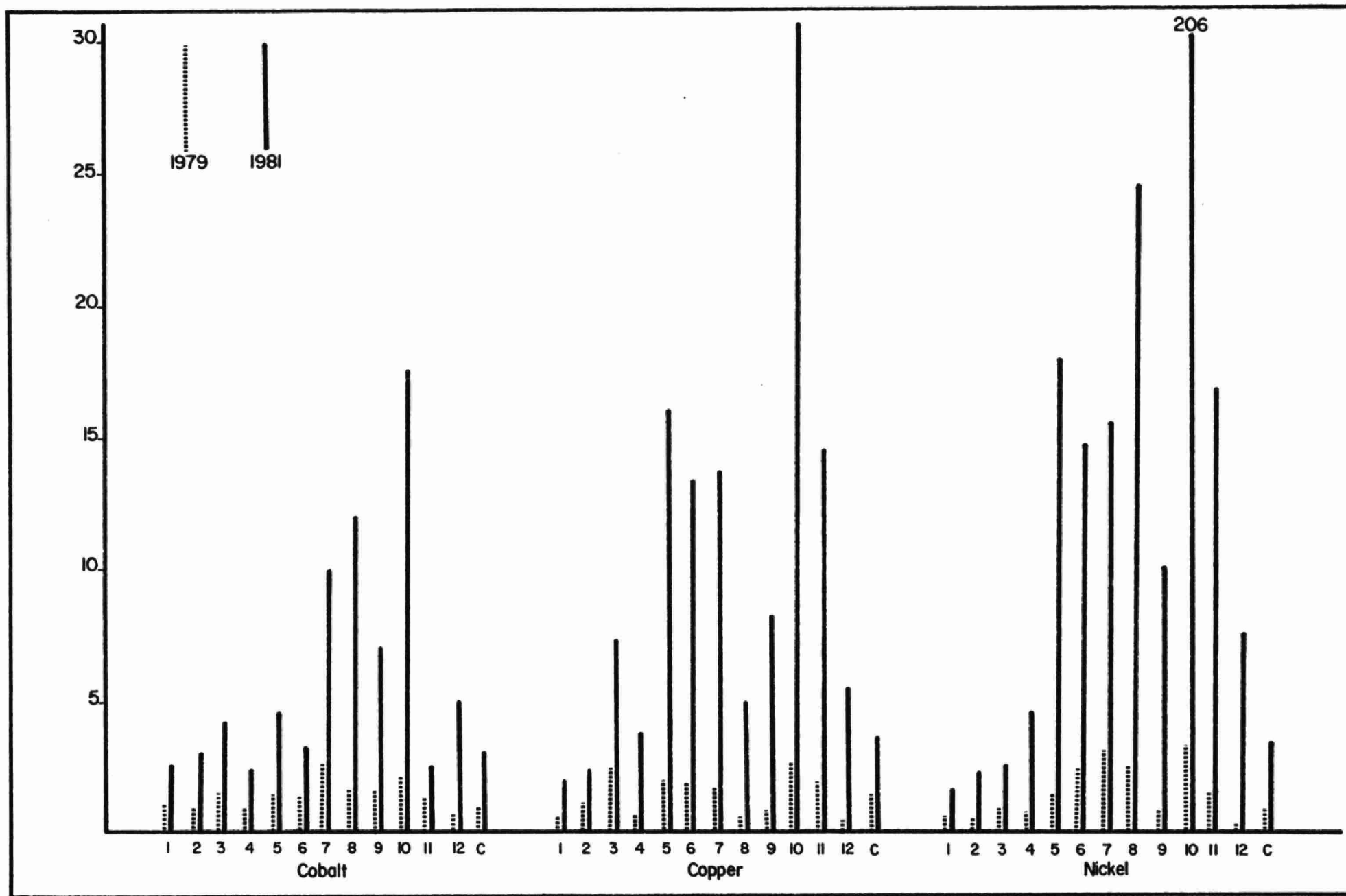


Figure 3. Enrichment factors in exposed moss (normalized to iron), Shebandowan, 1979 and 1981.

TABLE 1. Levels of cobalt, copper, iron and nickel ($\mu\text{g/g}$, dry weight) in soil and exposed moss at Inco Metals Limited, Shebandowan. Moss was exposed from May 8 to June 5, 1979 and from June 2 to July 2, 1981.

Site	Cobalt			Copper			Iron			Nickel		
	1979		1981 moss	1979		1981 moss	1979		1981 moss	1979		1981 moss
	soil	moss		soil	moss		soil	moss		soil	moss	
1	12	1	2	150	8	20	21000	1700	1400	210	10	25
2	9	<1	2	56	7	10	16000	1800	1200	72	4	12
3	6	<1	<2	17	5	10	16000	1900	1300	24	3	5
4	9	<1	<2	120	9	46	17000	1900	1700	110	10	49
5	10	<1	3	42	6	44	23000	1700	1500	58	6	68
6	13	<1	<2	36	4	24	26000	1500	1300	47	7	35
7	11	2	12	120	17	180	21000	1400	2300	180	38	310
8	18	2	26	690	25	420	30000	2000	3600	230	42	670
9	17	2	14	200	13	190	20000	1400	2300	290	20	340
10	10	2	61	83	22	880	20000	1900	6900	110	35	7900
11	10	1	2	41	7	49	22000	1800	1800	52	7	68
12	22	<1	10	330	7	160	25000	1600	2200	440	5	290
Exposed controls	15	<1	<2	39	4	6	23000	1500	950	29	2	4
Unexposed controls		<1	<2		4	7		1900	1100		4	4

DISTRIBUTION LIST

Report on: Moss exposure experiment in the vicinity of Inco
Metals Limited, Shebandowan, June, 1981

Northwestern Region: Director
Manager, Technical Support
Manager, Industrial Abatement
District Officer, Thunder Bay

Environmental Approvals Branch: Senior Approvals Engineer
Regions 5&6, Industrial
Approvals Section
(E. O'Keefe)

Northeastern Region: Chief, Air Quality Assessment

Waste Management Branch: Manager, Industrial Section
(B. I. Boyko)

Laboratory Services Branch: Director
Vegetation Supervisor
Air Quality Supervisor

Air Resources Branch: Director
Supervisor, Air Quality & Meteorology
Section
Supervisor, Phytotoxicology Section

Ministry of Labour: Special Studies & Services Branch: Director
Mining Health and Safety Branch: Director;
Area Engineer, Thunder Bay

Canadian Pacific Limited: Superintendent, Lakehead Division

Inco Metals Company Limited, Shebandowan: Plant Manager



Ontario

7530 - 1239

Letter size - 1/2 cut tab

FASTENER

LABORATORY LIBRARY



96936000119567



LABORATORY & RESEARCH LIBRARY
MINISTRY OF THE ENVIRONMENT



Ontario

7530 - 1239

Letter size - 1/2 cut tab

▽